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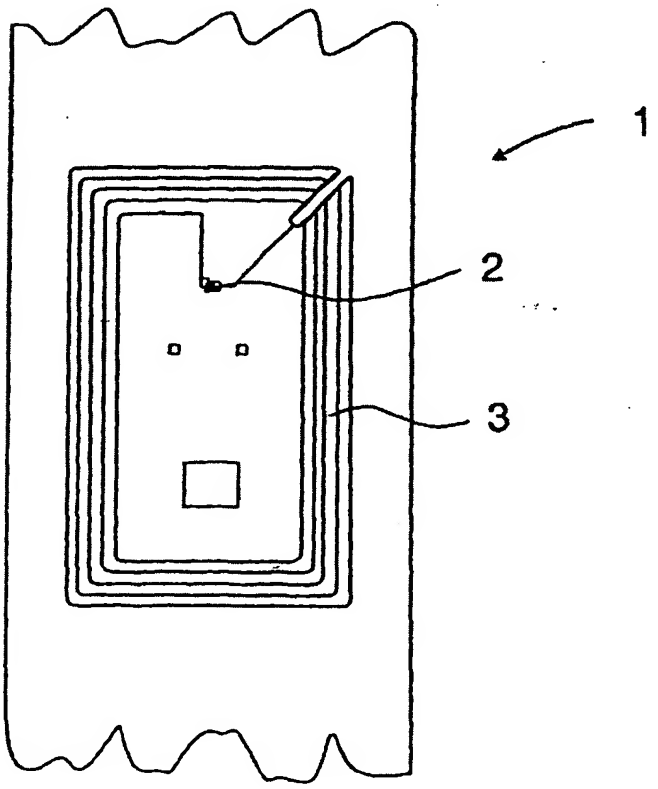
(54) Title: SMART LABEL



(57) Abstract: The present invention relates to smart label including a polyolefin substrate comprising a circuitry pattern and an integrated circuit on a chip. The substrate comprises 30 - 80 wt-% of a mineral filler.

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SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Smart label

The present invention relates to a smart label including a polyolefin substrate comprising a circuitry pattern and an integrated circuit on a chip. The present invention also relates to a moulded polyolefin product comprising an in-mould smart label including a polyolefin substrate comprising a circuitry pattern and an integrated circuit on a chip.

Smart labels comprising a circuitry pattern and an integrated circuit on a chip are used for example for identifying and following certain products. They form an easy and cheap surveillance system if a reader device is available.

On the other hand, there is a need for labels which can be put inside a product or on a surface of the product during a moulding process to obtain identifiable products from which the smart label cannot be removed without breaking the product. The normally used raw materials for in-mould labels are biaxially oriented polypropylene (BOPP), high density polyethylene (HDPE) and low density polyethylene (LDPE) because it is advantageous to use the same material in the label as in the moulded product due to the possibility of recycling. The most common raw materials used in moulded products, especially in food, beverage, flower, petrochemical, personal hygiene or household product industries, are polyolefins, such as high density polyethylene (HDPE) and polypropylene (PP). In this context the moulding process refers to moulding processes known as such, for example an injection moulding process or a blow moulding process.

There are, however, certain obstacles for manufacturing such smart labels which can be used in in-mould products. The attachment of the chip to the circuitry pattern may require high temperatures, and therefore films which are normally used as a substrate for in-mould labels cannot be used. The required temperature may be 150 - 180°C, and the duration of the treatment may be 5 – 8 seconds. It means that the normally used films melt, burn or shrink. For example polyester would have a high enough thermostability but it cannot be used with polyolefins because products made of polyolefins shrink approximately

2 % after moulding and polyester maintains its dimensions. Further, the adhesion of the polyester film to polyolefins is not perfect either, and recycling is not possible when a film with a different raw material basis is used.

The present invention brings an enhancement to the known technique. The smart label and the in-mould product of the invention is characterized in that the substrate comprises 30 – 80 wt-% of a mineral filler.

The films of the invention contain mineral fillers to enhance the heat resistance of the film. The films contain 30 – 80 wt-% of a mineral filler, such as talc, chalk, calcium carbonate ($CaCO_3$), titanium dioxide (TiO_2), silica, or mixtures of these. The preferred mineral filler content is 50 – 70 wt-%. The film can be manufactured for example by casting or blowing. It can be non-oriented, machine direction oriented, cross direction oriented or biaxially oriented. The film may contain more than one layer, and it may be coated on one side or both sides. Its appearance may be matt or glossy, and it may be translucent or opaque. Its colour may be anything. Its thickness is preferably 30 – 250 µm.

In the present application, smart labels refer to labels comprising an RF-ID circuit (identification). A smart label web can be formed of the film of the invention in a continuous process. The smart label web is a web that is flexible but still has a suitable rigidity. The smart label web consists of a sequence of successive and/or adjacent smart labels. The circuitry pattern can be manufactured by printing the circuitry pattern with an electroconductive printing ink on a film, by etching the circuitry pattern on a metal film, by punching the circuitry pattern from a metal film, or by winding the circuitry pattern of for example copper wire. Typically the circuitry pattern is formed by etching it on the metal film. The electrically operating RFID (radio frequency identification) circuit of the smart label is a simple electric oscillating circuit (RCL circuit) operating at a determined frequency. The circuit consists of a coil, a capacitor and an integrated circuit on a chip. The integrated circuit comprises an escort memory and an RF part which is arranged to

communicate with a reader device. Also the capacitor of the RCL circuit can be integrated in the chip or it can be located outside the chip. When the capacitor is located outside the chip, it is formed by plates on the smart label web and the structural part. The plates are located one upon the other thereby forming the capacitor in a ready smart label.

Methods for attaching the integrated circuit on the chip to a circuitry pattern include the flip-chip technology which comprises several techniques. The flip-chip technology can be selected from a large variety in such a way that the production rate of the process can be maximized at an appropriate level of quality and reliability. Suitable flip-chip methods include anisotropically conductive adhesive or film (ACA or ACF) joint (the required process temperature >140°C), isotropically conductive adhesive (ICA) joint (the required process temperature >140°C), non-conductive adhesive (NCA) joint (the required process temperature >140°C), solder flip-chip (FC) joint (the required process temperature approximately 220°C), or possibly other metallic joints. In addition to the flip-chip technology, also a wire bond or a joint made by tape automated bonding (TAB) can be used. Also joints made by polymer based thermoplastic adhesives can be used (the required process temperature 140 - 200°C). The chip can also be placed by the flip-chip technology onto a separate structural part which is attached to the circuitry pattern.

The smart labels of the invention can be delivered to be used as in-mould labels in a web form with or without a backing film. The web may be perforated. When the web has the backing film it is preferably a non-adhesive dry-peel film on which the die-cut smart labels are located. The web can be in roll form or fan folded. It is also possible that the web is sheeted to sheets containing one or more smart labels.

On the smart label web, the chip can be plain or it can be covered by a film which protects the chip and the circuitry pattern against moisture and chemicals. The protective film may be for example a coextruded film based on polyolefins. The thickness of the film is preferably 10 – 200 μm. Another possibility is to adhere a layer of a shock-absorbent

rubber compound. The smart label may be inserted on the surface of the product with either the front or the reverse side in contact with the product, or the smart label may be embedded in the product.

When a blow moulded product is in question, the reverse side of the smart label web shall include an adhesion layer whose melting point is lower than that of the smart label substrate because the blow moulding process takes place at a lower temperature than injection moulding. Thus, to achieve a good adhesion, an extra layer is required. The smart label made by the blow moulding process is attached to the product so that the adhesion layer faces the moulded product, or the smart label may be embedded into the product.

In the following, the invention will be described by means of a drawing. Fig. shows a single smart label in a top view.

Figure 1 shows a single smart label in a top view. The smart label web 1 is a continuous web which contains circuitry patterns 3, each having an integrated circuit on a chip 2, at suitable spaces one after another and/or next to each other. The material of the web is polyolefin containing 30 – 80 wt-% of a mineral filler. The circuitry pattern 3 can be made by printing the circuitry pattern on a film with an electro-conductive printing ink, by etching the circuitry pattern on a metal film, by punching the circuitry pattern off a metal film, or by winding the circuitry pattern of *e.g.* a copper wire. The circuitry pattern is provided with an identification circuit, such as a radio frequency identification (RFID) circuit. The identification circuit is a simple electric oscillating circuit (RCL circuit) tuned to operate at a defined frequency. The circuit consists of a coil, a capacitor and a circuit integrated on a chip, consisting of an escort memory and an RF part for communication with a reader device. The capacitor of the RCL circuit can also be integrated on the chip or the capacitor/s can be located outside the chip.

Example.

In-mould smart labels comprising a circuitry pattern and an integrated circuit on a chip were manufactured from commercial polyolefin films

comprising 30 – 80 wt-% of a mineral filler. The used films were FPO® films 3966, 3969, 3970 and 3965 manufactured by RKW Sweden AB (Sweden), Leanfilm manufactured by Ecolean AB (Sweden) and Teslin® synthetic printing sheets SP-700, SP-800, SP-1000, SP-1400 and SP-1800 manufactured by PPG Industries, Inc. (USA). The FPO® films were polypropylene films whose thickness varied from 70 to 110 µm, the filler was a combination of chalk and talc and the filler content was 51 wt-% according to ISO 3451-1. These films resist well temperatures of at least 160°C. All the films sustained well the manufacturing process of the smart label and its moulding into a product.

The invention is not restricted to the description above, but the invention may vary within the scope of the claims. The main idea in the invention is that the polyolefin substrate of the smart label can be made thermoresistant by a certain amount of mineral fillers.

Claims:

1. A smart label including a polyolefin substrate comprising a circuitry pattern and an integrated circuit on a chip, **characterized** in that the substrate comprises 30 – 80 wt-% of a mineral filler.

2. The smart label according to claim 1, **characterized** in that the mineral filler is talc, chalk, calcium carbonate ($CaCO_3$), titanium dioxide (TiO_2), silica or mixtures of those.

3. The smart label according to claims 1 or 2, **characterized** in that the polyolefin substrate is a biaxially oriented polypropylene (BOPP), a high density polyethylene (HDPE) or a low density polyethylene (LDPE).

4. A moulded polyolefin product comprising an in-mould smart label including a polyolefin substrate comprising a circuitry pattern and an integrated circuit on a chip, **characterized** in that the substrate comprises 30 – 80 wt-% of a mineral filler.

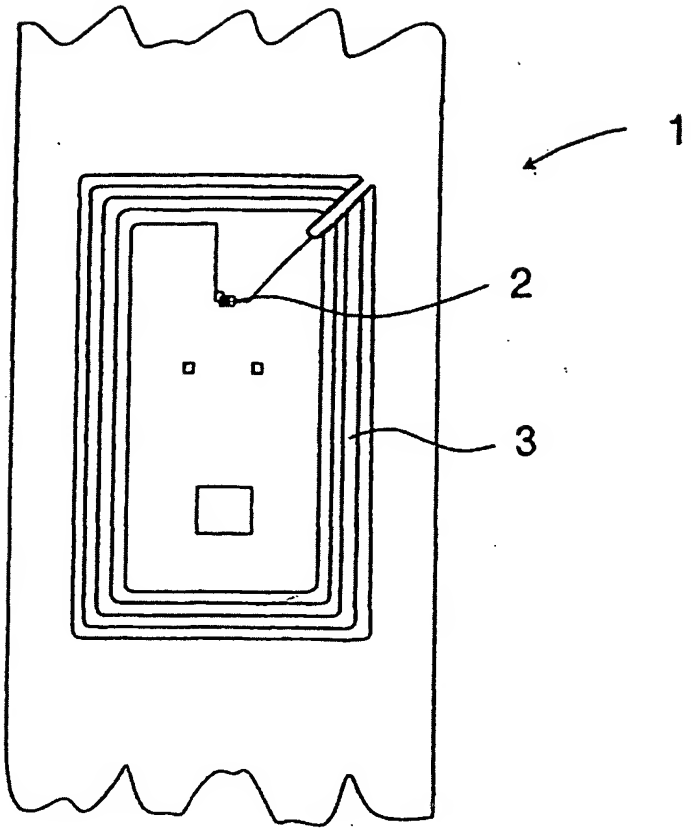

Fig. 1

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

IPC7: G06K 19/077, G09F 3/02
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B32B, G06K, G09F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 9714112 A1 (MOTOROLA INC.), 17 April 1997 (17.04.97), page 20, line 11 - line 15, abstract --	1-4
Y	EP 0575631 A1 (ROTA-DRUCK W. KLESER KG), 29 December 1993 (29.12.93), column 3, line 6 - line 55, claims 1,11,12, abstract --	1-4
A	EP 0922555 A1 (ALLIBERT EQUIPEMENT), 16 June 1999 (16.06.99), figures 1-5, abstract --	1-4

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 May 2003	30-05-2003
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Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 5302431 A (MARVIN I. SCHULTZ), 12 April 1994 (12.04.94), column 2, line 10 - line 30; column 4, line 44 - line 49 --	1-4
A	US 6206292 B1 (BERND ROBERTZ ET AL), 27 March 2001 (27.03.01), column 1, line 13 - line 20; column 2, line 19 - line 25; column 2, line 59 - line 65, abstract --	1-4

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Information on patent family members

29/04/03

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